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HENRY S. GRAVES, Forester.

"COLOMBIAN MAHOGANY"

(*Cariniana pyriformis*).

ITS CHARACTERISTICS AND ITS USE AS A SUBSTITUTE FOR TRUE MAHOGANY

(*Swictenia mahagoni*).

BY

GEORGE B. SUDWORTH, DENDROLOGIST,

AND

CLAYTON D. MELL, ASSISTANT DENDROLOGIST,

Forest Service.

WITH A DESCRIPTION OF THE BOTANICAL CHARACTERS OF CARINIANA PYRIFORMIS,

BY

HENRY PITTIER,

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"COLOMBIAN MAHOGANY."

INTRODUCTION.

The purpose of this circular is to present to users of cabinet woods the distinguishing characteristics of one of the best imitation mahoganies now marketed. The trade name of this wood is "Colombian mahogany," so called because it comes only from Colombia. It is not mahogany, however, but belongs to an entirely different family of trees, the monkey-pod family, *Lecythidaceæ*, and is technically known as *Cariniana pyriformis* Miers (figs. 1 and 2). The true mahogany, *Swietenia mahagoni* Jacq. (figs. 7 and 8) is a member of the family *Meliaceæ*, to which the well-known China tree belongs. "Colombian mahogany" and true mahogany are botanically as unlike as an oak and a maple, but a superficial resemblance in the grain and color of their woods has made it possible to substitute the Colombian wood for the other.

Since *Cariniana pyriformis* is not mahogany, the trade name "Colombian mahogany" is a misnomer. It is probable, however, that because the wood comes entirely from Colombia it will continue to be known by its present name, though a more fitting one would be Cariniana.

How long the wood of *Cariniana pyriformis* has been used in the United States is not known. It has been exported from Cartagena, Colombia, to Havre, France, however, for more than 30 years and there sold in immense cargoes as genuine mahogany. Practically all the "Colombian mahogany" now marketed is cut at points from 100 to 200 miles inland and shipped from Cartagena. The trunks of the trees are straight and cylindrical, from 24 to 70 inches in diameter, with an average of about 36 inches, and often with a clear length of 50 feet.

The great popularity of true mahogany as a furniture and finishing wood has caused a steady depletion of the available supply ever since its earliest use, in about 1724. Few users of mahogany realize that the consumption of material passing in the markets as mahogany amounts annually to about 40,000,000 feet, while the cut of real mahogany is only about 18,000,000 feet. This does not mean so much that deliberate deception is being practiced as it does that the demand for true mahogany greatly exceeds the supply. In consequence the

producers of mahogany have had to seek substitutes in order to meet the demand. Over 20 mahogany-like woods are now offered as true mahogany, not to mention a considerable number of woods cunningly stained to imitate that wood. While the consumer may derive as much satisfaction from an article made of imitation mahogany as from one made of the genuine wood, the discovery that real mahogany has not been obtained is nevertheless ground for just complaint.

It seems possible now, when the demand for mahogany is greater than the supply, that there could be an accepted use for such woods as Cariniana, acknowledged not to be mahogany, but which are so similar to it in color, grain effects, and working qualities as to serve for the rarer wood. There should be no objection to calling such woods by their proper names. Moreover, unless all good substitutes for mahogany were used, it would be impossible to meet the demand.

Cariniana pyriformis first became known botanically in 1874, while true mahogany was first described in 1760. Adequate information regarding the botanical characteristics of *Cariniana pyriformis*, and of the structural nature of the wood, has never before been published. In order, therefore, to present here as complete an account as possible of the species, a careful study has been made of the wood, foliage, and fruit; flowers of the tree could not be obtained. Corrections are also made here of errors current in technical works as to the origin of the botanical specimens of Cariniana previously collected.

BOTANICAL CHARACTERS.

Young twigs (fig. 1, *a*) are slender, flexible, with an alternate, two-ranked arrangement; the older twigs have a reddish gray bark beset with little warts, while the younger ones are smooth and shiny.[1] The leaves are alternate and two-ranked, and smooth except on their midveins; leaf-stalks slightly hairy or downy, 3 to 4 millimeters[2] long; leaf-blades 5 to 10 centimeters[3] long, and 2 to 3.5 centimeters wide, varying in form from elliptic ovate to elliptic, with bases usually long-acuminate, but sometimes rounded, or slightly acute; dark green above, paler and densely covered with minute white dots beneath; margins of the leaves with very fine teeth which are sometimes rounded (fig. 1, *b*); midvein and side veins prominent on the lower side, the former being slightly hairy and opposite near the base of the leaf, but becoming alternate toward the apex, while the side veins have very fine hairs in their corners and are regularly alternate.

The fruit (pyxidium), of a dark brown color, is somewhat pear-shaped, flattened at the apex, 6.5 to 7.5 centimeters in length and

[1] It was impossible to determine from the dried specimens the color the younger twigs have in the green condition.

[2] A millimeter is about one twenty-fifth of an inch.

[3] A centimeter is about two-fifths of an inch.

FIG. 1.—*Cariniana pyriformis: a,* Twig and leaves, natural size; *b,* magnified portion of the serratures on the margin of the leaf.

almost 5 centimeters in diameter (fig. 2, *a*, *b*); the zone (calycary) where the sepals are attached is from 5.5 to 6 centimeters from the base of the fruit. The exterior face of the stopper-shaped lid (operculum), which has a small pit-like depression at the center, is from 2.5 to 3 centimeters in diameter and 0.8 to 1 centimeter thick (fig. 2, *c* and *e*). The three-angled axis (columella), to which the seeds are attached (fig. 2, *e*), is from 5 to 5.5 centimeters long, strongly joined to the operculum, its plane faces from 1 to 1.5 centimeters broad at the upper part, the margins of the faces slightly thickened and protruding (fig. 2, *e* and *g*). The three-angled seeds (fig. 2, *f*), 1 to 5, but usually 5, in each cell, are from 13 to 15 millimeters long, from 5 to 6 millimeters broad, obovate-elongate, and more or less broadly winged on the two angles in contact with the columella. The seeds occur more or less regularly in two rows, overlapping one another, and most of them are attached transversely on the columella.

Although the measurements of the fruit taken by Miers (the original describer of Cariniana) were evidently from larger specimens, his description and drawings agree so well with the specimens recently collected as to leave no doubt but that this later obtained material is properly referable to *Cariniana pyriformis*.

There remains, however, one point to be made clear, namely, the origin of the fruits studied by Miers, and the authority for citing the tree as a native of Bolivia, an error, it is believed, which was followed by the Kew Index and by subsequent authors. Alluding to the origin of the fruit, Miers writes: "The label attached to the Linnean Society specimen, in Antoine's handwriting, says, 'Between riviere sinu Plato Bolivia, New Granada,' which should possibly be interpreted to mean some small river Betanie flowing into the Magdalena near Plato." It is more likely, however, that the correct reading of Antoine's label is *Betancí, rivière Sinú, Etat de Bolivar, Nouv. Grenade* On Pereira's [1] map of the State of Bolivar there is a Betanci Lagoon (Cienaga de Betanci) close to the Sinu River and at the foot of the last spurs of Antioquia Mountains (Serrânia de San Jerónimo). This same lagoon is seen again, with the name even more distinctly written, on the map of the State of Antioquia accompanying Miers's work.

But even with Miers's strange reading of Antoine's label it is difficult to see how the final interpretation was arrived at of giving Bolivia, in the central part of the South American continent, as the native country of this tree. That the tree grows in the low lands of the former State of Bolivar, in Colombia, is confirmed by the specimens here described, which are known to belong to the commercial timber imported from Colombia to the United States under the name of "Colombian mahogany."

[1] Pereira, Ricardo S. Les Etats-Unis de Colombie (Paris, 1883), map fronting p. 177.

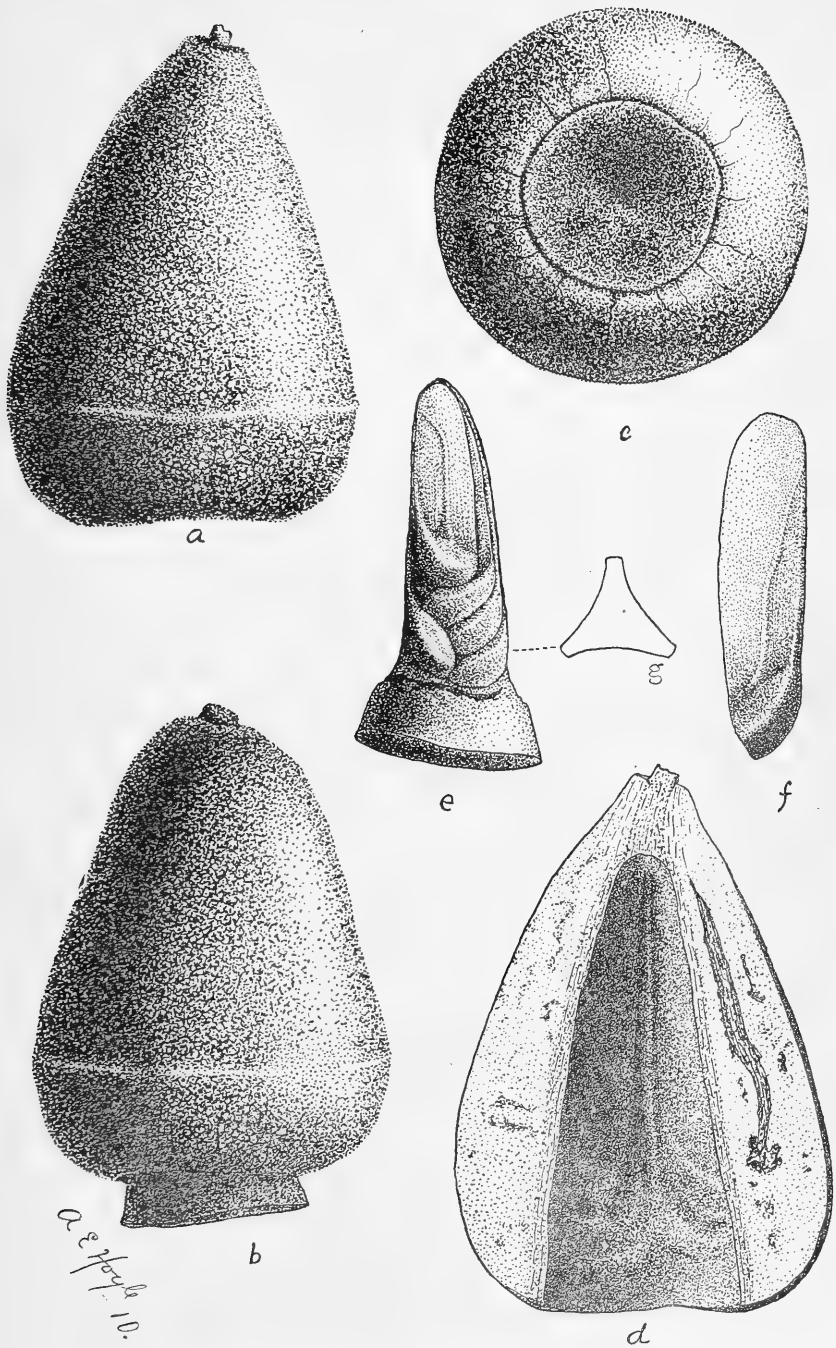

FIG. 2.—*Cariniana pyriformis: a*, Fruit or woody seed capsule (pyxidium) showing calycary zone (where the sepals are attached); *b*, fruit with stopper-like lid (operculum) partly protruding; *c*, fruit (pyxidium) showing circular outline of the operculum plane at the base with the small pit-like depression in the center; *d*, longitudinal section of the woody seed capsule with the stopper-like lid (operculum) removed; *e*, columella (three-sided axis to which seeds are attached) with seeds attached; *f*, seed removed from the axis (columella) showing wing; *g*, transverse section of the columella. All natural size.

PHYSICAL PROPERTIES OF THE WOOD.

While Cariniana differs widely in its botanical and anatomical characters from true mahogany, its close superficial resemblance to mahogany and its physical properties at once distinguish it as a high-class cabinet wood. The wood does not exhibit true annual layers of growth, a characteristic also of true mahogany, especially that obtained from near the southern part of the tree's range. When properly seasoned it does not warp, check, or shrink, while much of the lumber is beautifully figured. It works well, takes a filler readily, and can be highly polished. There is no reason why it should not be employed for all purposes for which true mahogany is used. The wood is hard, heavy (42 pounds to the cubic foot, with a specific gravity 0.674), strong, and tough, and in color and weight compares almost exactly with genuine mahogany. Those who work Cariniana wood observe that it dulls the saws and other tools very quickly, a fact which first cast suspicion on it as not being real mahogany and led to its study by the Forest Service. The following is a chemical analysis of the wood.[1]

	Per cent.
Insoluble in concentrated acid	53.4
Lime	29.9
Magnesia and traces of iron and soda	2.5
Carbon dioxide, with small amount of unburnt carbon, and phosphoric acid	16.2

A microscopical examination of the wood shows a great abundance of crystals of calcium oxalate and calcium carbonate in the wood-parenchyma fibers (fig. 5, *b*). These fibers are abundant, and are scattered among the thick-walled wood fibers. The flinty and insoluble crystals of calcium oxalate doubtless have a great deal to do with the dulling of the saws experienced in milling this timber. Moreover, the walls of the wood fibers are very thick (fig. 4, *b*), leaving only very small cavities, which adds considerably to the density and hardness of the wood.

MINUTE CHARACTERS OF THE WOOD.

The pores or vessels (fig. 6, *a*), as seen in transverse section are conspicuous, though not very numerous, and are evenly distributed throughout, singly for the most part, but occasionally subdivided by partition walls that are either oblique or at right angles to the pith rays. Seldom are more than two pores grouped radially, in which case one is always quite small. Solitary pores have small to moderately large cavities (0.15 to 0.4 millimeter) with an average of about 0.3 millimeter in radial diameter. (Exceptionally small pores, which occur occasionally, are not included in this average diameter.) The

[1] Made by F. P. Veitch, Chief of the Leather and Paper Laboratory, Bureau of Chemistry.

tangential diameter is somewhat smaller than the radial diameter because all single pores are slightly elliptical. Walls of the pores are moderately thin, and the cavities of the pores are usually filled with

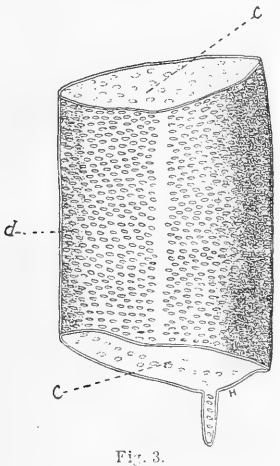

Fig. 3.

Fig. 5.

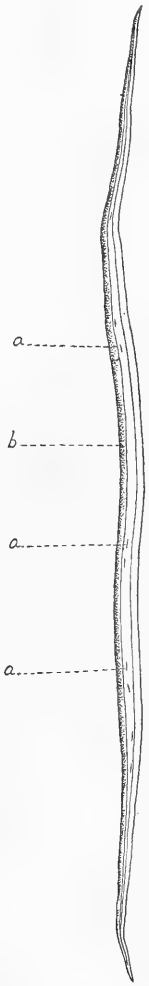

Fig. 4.

FIG. 3.—Segment of a vessel (separated) from the wood of *Cariniana pyriformis*, showing the character and arrangement of the pits, also showing the complete absorption of the end walls at *c*; *d*, bordered pits. Magnified about 100 diameters.

FIG. 4.—Wood fiber (separated) of *Cariniana pyriformis: a*, Slitlike pits; *b*, thick wall wood fiber. Magnified about 100 diameters.

FIG. 5.—Wood-parenchyma fiber (separated) of *Cariniana pyriformis: a*, Individual cells; *b*, crystals of calcium oxalate; *c*, pits and their arrangement. Magnified about 100 diameters.

tyloses.[1] (Compare transverse section of Cariniana, fig. 6, *d*, with that of true mahogany, fig. 11, *a*. A segment or part of a separate

[1] Tyloses consist of reddish brown masses of parenchymatous cells which grow through the pits or unthickened portions of the vessel walls and protrude into the vessel cavity. They form partition walls at irregular intervals throughout the entire length of the tube.

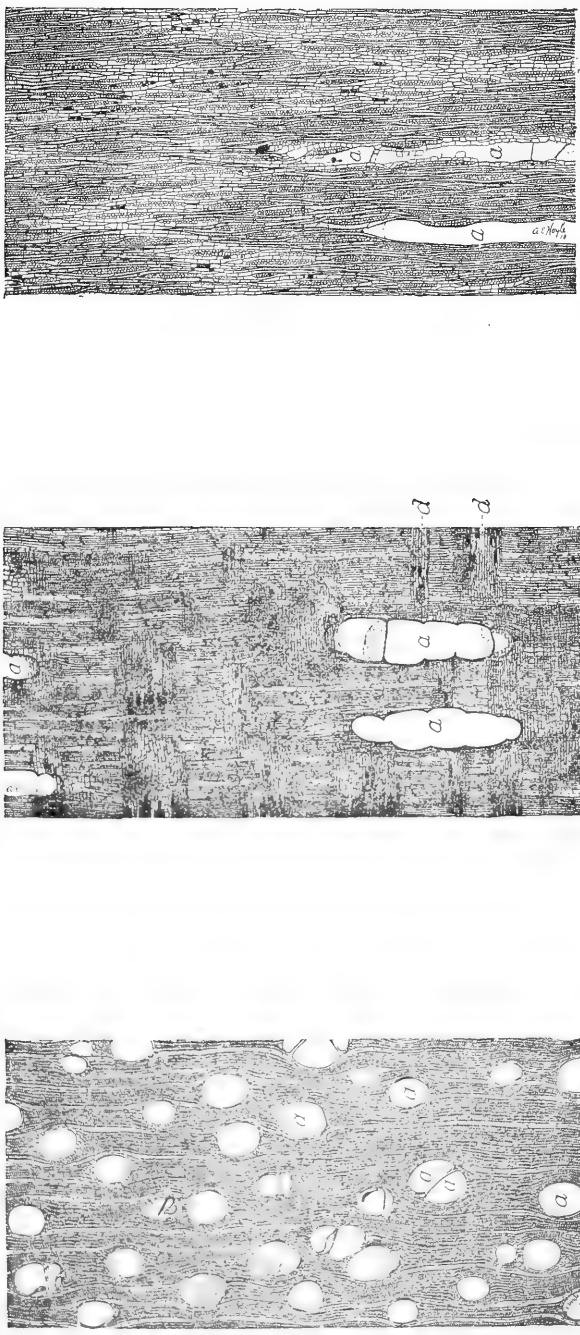

FIG. 6.—Transverse, radial, and tangential sections of *Cariniana pyriformis*: *a*, Vessel; *b*, wood fibers; *c*, wood-parenchyma fibers; *d*, pith ray. Magnified 20 diameters.

vessel of the wood of Cariniana is shown in fig. 3, with which compare the segment of a vessel from the wood of true mahogany, fig. 9, *a*.)

Vessels are seen to best advantage in longitudinal sections (figs. 6, *a*, and 11, *a*); individually the segments of which the vessels are composed are from 1 to 2, or occasionally from 3 to 4, times as long as wide, and as a rule their end walls are finally wholly absorbed (fig. 3, *c*). These end walls are occasionally at right angles to the vessel, but they are more often slanting surfaces always facing the pith rays. The side walls have small, round, or elliptical, bordered pits,[1] arranged in numerous perpendicular rows (fig. 3, *d*). The pits in the vessel walls of *Swietenia mahagoni* are usually smaller and are arranged more or less in groups (fig. 9, *d*).

Wood fibers (fig. 6, *b*) are arranged in several or many radial rows between the pith rays (fig. 6, *d*) and form the principal bulk of the wood. (Contrast the arrangement of these fibers with that of those of true mahogany, fig. 11, *b*.) Broad tangential bands of these elements alternate with obscure narrow lines of wood-parenchyma fibers (fig. 6, *c*), which are clearly shown in both the transverse and radial sections, when magnified 20 times the natural size. Wood fibers having rather thick walls (fig. 4, *b*) and relatively small cavities are seldom flattened, even in the region of vessels, which is true also of most other woods with conspicuous pores. Wood fibers vary in length from 0.97 to 1.6 millimeters, with an average of 1.29 millimeters, while the average width is about 0.02 millimeter. The pits in the radial walls of wood fibers are simple [1] and slitlike (fig. 4, *a*). A characteristic of true mahogany wood fiber is that it possesses cross partitions (fig. 10, *a*) in striking contrast to the wood fiber of Cariniana, in which there are no cross partitions (fig. 4).

Wood-parenchyma fibers (fig. 5) form very narrow bands which are arranged at right angles to the pith rays (fig. 6, *c*). These bands are usually 1, occasionally 2, and rarely 3 cells wide, and are visible with a pocket lens magnifying from six to eight times natural size. The wood is traversed by these very fine, light-colored, wavy bands, which sometimes join one another or end abruptly when they meet a pore, or in their undulating course are bent around the pores. These narrow lines, not to be confounded with annual rings of growth, are about as numerous as the pith rays themselves, and with them form a meshlike structure. In true mahogany the wood-parenchyma fibers for the most part surround the vessels and pith rays (fig. 11, *c*).

[1] Pits are unthickened portions in the walls of wood elements. These are either round, elliptical, or slitlike, and are further divided into simple and bordered pits. Whether a pit is simple or bordered is determined by the character of the canals which extend from the middle lamella, or common wall of two adjacent elements, to the cavity of the cell. When a transverse or longitudinal section is made, a profile view of pits will be seen, and if the walls of the canal are nearly parallel or diverge only slightly toward the common wall, as is shown in fig. *a*, it is a simple pit. If the walls of the canal make a distinct angle just inside the pit opening, as shown in fig. *b*, it is a bordered pit.

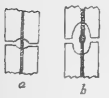

FIG. 7.—*Swietenia mahagoni: a*, Stem and leaf, natural size; *b*, flowering branch, natural size; *c*, flower, natural size.

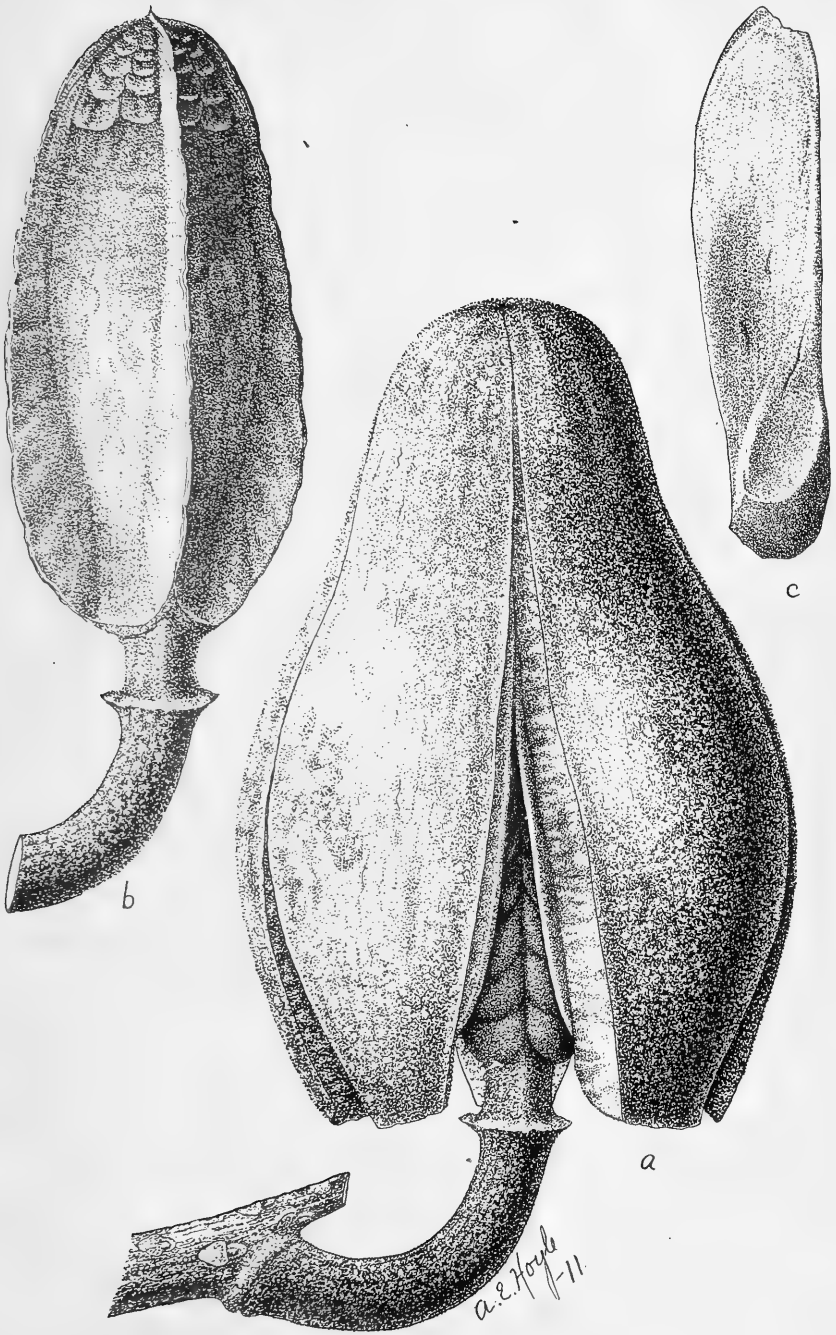

FIG. 8.—*Swietenia mahagoni: a*, A fruit; *b*, the axis of fruit, showing place of attachment of seeds at apex; *c*, winged seed. Two-thirds natural size.

The cavities of wood-parenchyma fibers of Cariniana (fig. 5, *a*) are usually filled with hardened, compact starch grains, certain resin derivatives, and crystals of calcium oxalate (fig. 5, *b*). These crystalline bodies appear in long perpendicular rows or irregular-

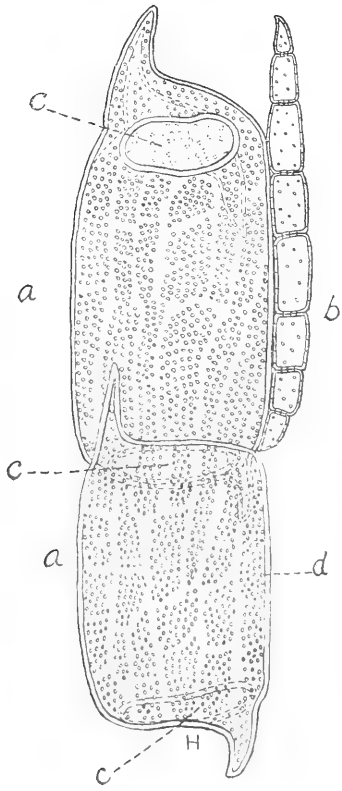

Fig. 9.

Fig. 10.

FIG. 9.—*a*, *a*, Two segments of a vessel; *b*, wood-parenchyma fiber; all separated from the wood of *Swietenia mahagoni*; *c*, shows complete absorption of the cross walls of each segment of a vessel; *d*, bordered pits. Magnified about 100 diameters.

FIG. 10.—Wood fiber (separated) of *Swietenia mahagoni*, showing cross partitions at *a*. Magnified about 100 diameters.

shaped nodules or angular granules, though generally they occur in a great variety of forms, tetragonal crystals being the most abundant. Each crystal is inclosed in a cubical crystal sac, and of which there

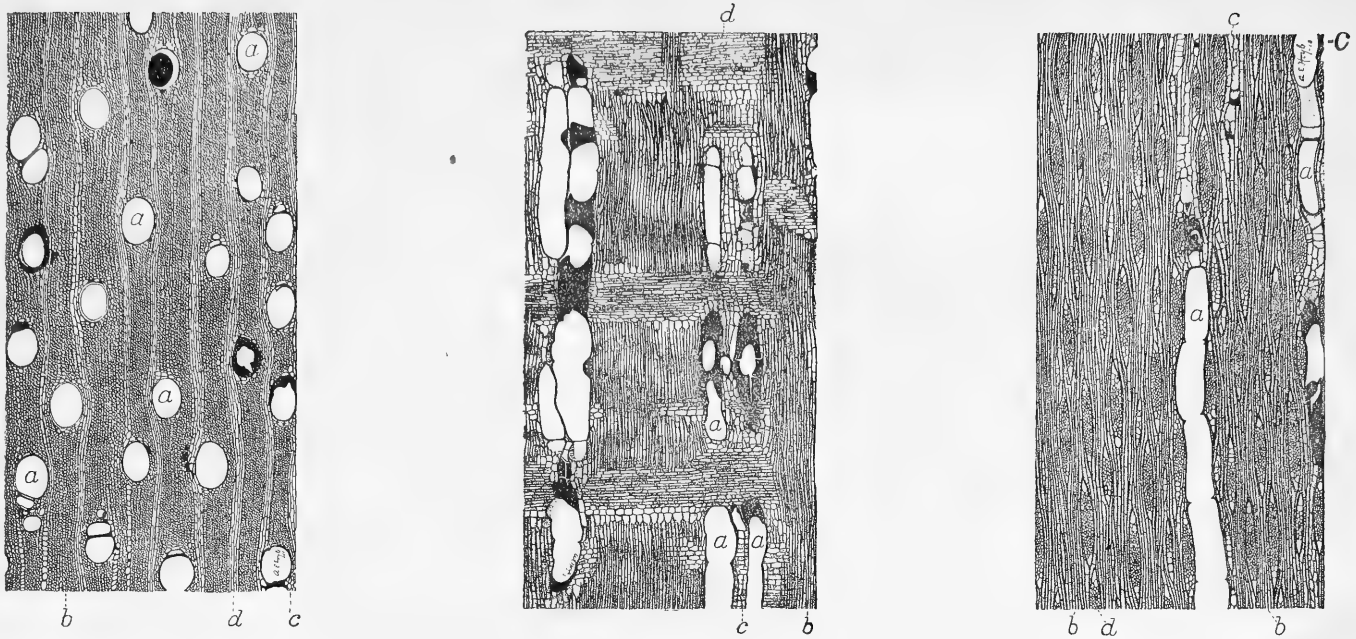

FIG. 11.—Transverse, radial, and tangential sections of *Swietenia mahagoni: a,* Vessel; *b,* wood fibers; *c,* wood-parenchyma fibers; *d,* pith ray. Magnified 20 diameters.

may be from a few to 10 or more in a single wood-parenchyma fiber, either occupying the whole or only a part of the fiber. (The wood-parenchyma fibers of true mahogany are similar to those of Cariniana, but smaller and contain crystals, fig. 9, *b*.)

Wood-parenchyma fibers are shorter than wood fibers, but their diameter is slightly greater. The walls of the former are much thinner and their cavities relatively larger than those of the latter. Wood-parenchyma fibers are subdivided by horizontal, oblique, or somewhat rounded cross walls, into from 6 to 10 cells. The upper and lower cells always have blunt ends, while the walls are marked by numerous simple pits, the latter being less numerous on the walls adjoining wood fibers, and largest on the terminal walls.

Pith rays (figs. 6, *d*, and 11, *d*) appear, under a pocket lens, as numerous, fine, uniform, slightly undulating, nearly equidistant lines, always growing around the larger vessels. The cells of which the rays are formed vary in form from oval, the commonest form, to oblong, and usually have oblique cross walls. As seen in tangential sections the pith rays are evenly distributed and constitute about 25 per cent of the wood mass. They are from 1 to 2, rarely 3, rows of cells wide, and from a few to 35 cells high. In tangential sections, the cells of pith rays are usually round and somewhat smaller in diameter than those of the wood-parenchyma fibers. The diameter of the upper and lower cells is larger in a vertical direction, but shorter in a horizontal direction. These marginal cells, as they are called, are only one-half as long as the ordinary pith-ray cells. The cavities of pith-ray cells are filled with a dark-brown mass consisting of starch grains and other materials, as yet unidentified. Crystals of calcium oxalate are seldom present in these cells. The walls of pith-ray cells are marked with simple pits, which are usually very numerous on the sides adjoining other pith-ray cells, and vessels, and wood-parenchyma fibers.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 22, 1911.*

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